United States
Department of
Agriculture

Forest
Service

Hoosier
National
Forest

Report for the Houston South Restoration Environmental Assessment

Effects to Soil and Water

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June, 2019

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Resource Impacts or Issue(s) Addressed

This section discloses the issues and potential impacts identified during interdisciplinary meetings and scoping. This is the soils and water resource report associated with the proposed Houston South Restoration project. The proposed actions will occur in Jackson and Lawrence Counties, Indiana. The resource concerns are:

- soil movement caused by disturbance and erosion
- soil compaction and rutting
- water quality degradation due to herbicide contamination or sedimentation
- disturbed natural surface water drainage patterns

Public concern about increased sedimentation and degrading water quality risks in the watershed that drains the project area have been a raised during public scoping.

Scope of the Analysis

Effects are analyzed in both the short- and long-term. Direct, indirect, and cumulative effects can occur within both time frames. Short-term effects to soils are those that occur over a decade or less. If recovery of the soil properties does not occur within the short-term, effects are then considered to be long-term. Soil formation and thus, soil replacement, are long-term processes that require a century or longer to occur.

The spatial boundaries used to evaluate **direct** consequences are the areas with proposed actions within the Houston South Project boundary. This spatial boundary was chosen because it can be used to determine threshold effects to soil and water quality from proposed actions**.** Direct consequences to soil and water are initial soil and water disturbances that affect soil productivity and water quality. Disturbances are: soil decomposition (compaction, rutting, and displacement), localized erosion/sedimentation, and point source water contamination. "Localized" infers that qualitative and quantitative measurable impacts do not progress beyond the project boundary. The project boundary area is approximately 19,620 acres. Approximately 4375 acres will have harvest activity with 401 total clear cut and the remainder thinned by selective, shelter wood, mid story, or selection harvest. Heavy equipment (skidders, trucks) will only be utilized in clear-cut, hardwood thinning, shelter wood thinning, pine thinning and selection. There will be a total of 16.4 miles of road work done to access timber. Existing road maintenance will require widening, culvert and drainage cleanouts and hardening as needed in areas to sufficiently haul timber. New construction will require converting legacy trails and roads to new roads and creating new roads on undisturbed ground. Road reconstruction will also require maintenance to bring old roads back to transportation specifications. Roads will have to be a minimum of 12 feet wide for equipment to pass safely. Landings and skid trails will be used mostly on ridgetops and flat areas to minimize disturbance.

Prescribed burning is proposed on 13,500 acres to reduce fuels and regenerate oak hickory forest. Manmade fireline will be created mostly with minimal disturbance using hand tools (blowers/trimmers, and chainsaws). 0.18 acres of dozer line will potentially be created.

Natural boundaries such as streams and drainages will be used as fireline to minimize disturbance.

Non-native invasive and silviculture treatments will be done using herbicides.

Three AOP's are proposed within the project boundary. A maximum of 4 acres will be disturbed during new crossing construction.

Watershed restoration techniques (big wood installation, armoring banks) in headwater streams for erosion control will occur to repair head cut and gullying. Watershed restoration will have minimal disturbance within the project boundary due to small sections of stream rehabilitated.

Indirect consequences are bounded to HUC 10 South Fork Salt Creek watershed with a drainage area of 102.4 square miles (USGS, 2019) approximately 30% of drainage inflow source to the neighboring Monroe Reservoir watershed (Jones, 1997). The South Fork Salt Creek watershed is set as the boundary due to many other unmeasurable indirect affects within the Middle Fork Salt Creek and North Fork Salt Creek watersheds that also feed into the Monroe watershed unrelated to the project. Indirect effects are accelerated erosion, soil decomposition, potential added nutrients to streams from existing in soils and eutrophication (from sediment and nutrients) of waterbodies. These effects are exacerbated by overland surface water flows after project implementation disturbances.

The spatial boundary used to address **cumulative** impacts are linked to the HUC 10 South Fork Salt Creek watershed. This boundary permits the assessment of past and future effects to soil and water. Cumulative effects, beyond the project site watershed boundaries, are not traceable to the project itself due to other land-use activities contributing to the more expansive watershed health. Sedimentation risks caused by the project could attribute to cumulative impacts if best management practices (BMP's) are not effective throughout the project implementation.

Methodology

Soil Monitoring

Harvest, burn, and transportation activities can cause detrimental soil disturbances. These disturbances can adversely affect vegetation, soil productivity and water quality. Monitoring for soil and site processes such as nutrient uptake and production is too costly and inefficient to monitor. Site processes have too many variables to consider: existing soil chemistry, variable moisture conditions, etc. The Forest Service has designed a practical method of soil disturbance monitoring which influences site processes that can be measured with set threshholds. Site quality is projected to be maintained if detrimental (DSD) is less than 15% of an area. Region 9 has set the DSD threshold to 20% (Powers, 1998). Timber layout, landings, roads, and skid trails will be designed to cause no more detrimental disturbance than 15% of the harvest area. This proposed disturbed area will be evaluated by implementing the Forest Disturbance Monitoring Protocol (USDA, 2009). Pre-harvest and post-harvest monitoring activities will be implemented at the start and end of the Houston South project to assess that the 15% of detrimental disturbance has not been exceeded. Forest floor impacted, topsoil displacement, rutting, burning (light, moderate, severe), compaction, platy structure/massive/puddled are all

indicators used by the Forest Disturbance Monitoring Protocol. Using the indicators, detrimental disturbance is rated using the figure below (USDA, 2009).

Figure 1- Table of disturbance class ratings used for Forest Disturbance Monitoring

Table 2.-*Soil disturbance classes used in the Forest Soil Disturbance Monitoring Protocol.* Soil *disturbance classes increase in severity of impact from class O to class 3. (1 of 2)*

Soil disturbance class O	**Soil disturbance class 1**
Soil surface: • No evidence of compaction; i.e., past equipment operation, ruts, skid trails. • No depressions or wheel tracks evident. • Forest floor layers present and intact. • No soil displacement evident. • No management-generated soil erosion. • Litter and duff layers not burned. No soil char. Water repellency may be present.	Soil surface: • Faint wheel tracks or slight depressions evident and are <5 cm deep. • Forest floor layers present and intact. • Surface soil has not been displaced and shows minimal mixing with subsoil. • Burning light: Depth of char <1 cm. ***Accessory****: Litter charred or consumed. Duff largely intact. Water repellency is similar to preburn conditions. Soil compaction: • Compaction in the surface soil is slightly greater than observed under natural conditions. • Concentrated from O to 1O cm deep. Observations of soil physical conditions: • Change in soil structure from crumb or granular structure to massive or platy structure; restricted to the surface O to 10 cm. • Platy structure is noncontinuous. • Fine, medium, and large roots can penetrate or grow around the platy structure. No "J" rooting observed. • Erosion is slight.

Table 2.-*Soil disturbance classes used in the Forest Soil Disturbance Monitoring Protocol. Soil disturbance classes increase in severity of impact from class O to class 3. (2 of 2)*

Soil disturbance class 2	**Soil disturbance class 3**
Soil surface: • Wheel tracks or depressions are 5 to 10 cm deep. • **Accessory*:** Forest floor layers partially intact or missing. • Surface soil partially intact and may be mixed with subsoil. • Burning moderate: Depth of char is 1 to 5 cm. **Accessory*:** Duff deeply charred or consumed. Surface soil water repellency increased compared with the preburn condition. Soil compaction: • Increased compaction is present from 10 to 30 cm deep. Observation of soil physical condition: • Change in soil structure from crumb or granular structure to massive or platy structure; restricted to the surface, 10 to 30 cm. • Platy structure is generally continuous. • ***Accessory*:*** Large roots may penetrate the platy structure, but fine and medium roots may not. • Erosion is moderate.	Soil surface: • Wheel tracks and depressions highly evident with depth >10 cm. • **Accessory*:** Forest floor layers missing. • Evidence of surface soil removal, gouging, and piling. • Most surface soil displaced. Surface soil may be mixed with subsoil. Subsoil partially or totally exposed. • Burning severe: Depth of char is >5 cm. **Accessory*:** Duff and litter layer completely consumed. Surface soil is water repellent. Surface is reddish or orange in places. Soil compaction: • Increased compaction is deep in the soil profile (>30 cm deep). Observations of soil physical conditions: • Change in soil structure from granular structure to massive or platy structure extends beyond 30 cm deep. • Platy structure is continuous. • **Accessory*:** Roots do not penetrate the platy structure. • Erosion is severe and has produced deep gullies or rills.

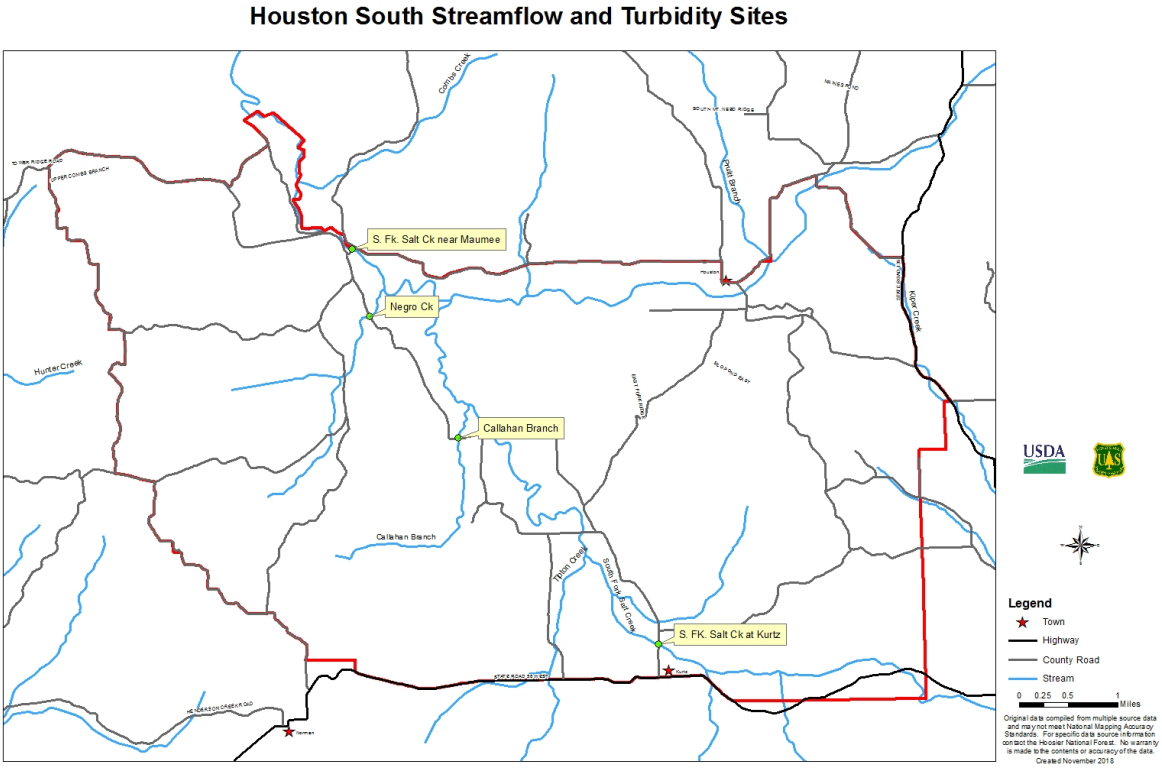
**Accessory items are those descriptors that may help identify individual severity classes.*

Water Quality Monitoring

The Forest Service follows BMP monitoring guidelines to protect water quality using the National Best Management Practices for Water Quality Management on National Forest System Lands Technical Guide (USDA, 2012).“ A National BMP program is needed as an effective tool for the agency to accomplish the following: Improve water quality to restore impaired waters, Improve relationships with EPA, States and the public, Improve the agency’s ability to demonstrate results in watershed management, Improve the agency’s ability to use adaptive management in land management plan implementation, and improve NEPA analyses and compliance with other Federal Laws.” (USDA, 2012). “The National BMP Program consists of four main components: (1) a set of National Core BMPs, (2) a set of standardized monitoring protocols to evaluate implementation and effectiveness of those BMPs (3) a data management and reporting structure and (4) corresponding national direction (USDA, 2012). All management activities of other resources are to be designed to minimize short-term impacts on the soil and water resources and maintain or enhance long-term productivity, water quantity, and water quality. BMP monitoring focuses around projects within the aquatic management zones (AMZ). An AMZ is a designated area near or around a stream channel and other waterbodies. AMZ delineation is site specific and may encompasses floodplain and riparian areas” (USDA, 2012). The AMZ is monitored for implementation and effectiveness of BMPs. Chemical treatments, road reconstruction and construction, pond and wetland construction/restoration, stream bank re-stabilization, facility use, prescribed burning, recreation activities are all addressed with the National BMP monitoring protocol. All of these activities will be monitored from implementation to effectiveness within the Houston South Project.

Since the South Fork Salt Creek watershed borders the municipal Monroe watershed, four sites are currently being monitored for stage, discharge and turbidity. The sites are: South Fork Salt at Kurtz, South Fork Salt Creek near Maumee, Negro Creek and Callahan Branch (figure2).

Figure 2 – Houston South Streamflow and Turbidity Sites



Background information on these sites are being collected to assess current water quality in relation to sediment. Soil disturbance is going to be the main risk to the watershed if BMP's fail or insufficient BMP's are utilized. Along with BMP inspections, turbidity will also be an indicator of water quality. Turbidity is the measure of clarity of water. Material that causes turbidity include clay, silt, inorganic and organic matter, algae, and dissolved colored organic compounds. Turbidity readings are commonly used to indicate increased sedimentation during soil disturbing projects. Baseline turbidity readings have been collected in association with discharges since stage (water levels) cannot be directly associated with turbidity due to backwater effects on South Fork Salt Creek from Lake Monroe. Backwater effect is pooling of accumulated water in a stream channel indicating high flow stages but less discharge associated with it. A non-backwater effect at same location may have the same high flow stage but a greater discharge. There is not a linear relationship between turbidity and discharge but higher turbidity readings are typically justified by higher flows. Baseline information listed in Table 1 below shows pre-harvest and pre-burn turbidity conditions driven by natural erosion, private land use and seasonal plant and algae growth. Turbidity monitoring will be ongoing throughout the life of the Houston South Project to ensure BMP's are effective. Higher turbidity can be associated with lower discharges depending on land use disturbances (agriculture, timber

harvest, etc.) within the area. If turbidity levels are monitored higher than control background information, further investigation and monitoring will be deployed to ensure BMPs are effective within the harvest unit.

Table 1 – Houston South Turbidity and Discharge Data

Houston South Turbidity and Discharge Data					
Callahan Branch			*Negro Creek*		
Date	**Discharge (cfs)**	**Turbidity (NTU)**	**Date**	**Discharge (cfs)**	**Turbidity (NTU)**
3/8/2019	1.38	1.68	*3/8/2019*	3.00	3.63
3/11/2019	9.95	3.62	*3/11/2019*	16.00	8.30
3/15/2019	13.5	5.9	*3/15/2019*	42.1	11.8
4/8/2019	3.23	2.77	*4/8/2019*	6.82	4.30
4/20/2019	64.3	19.6	*4/20/2019*	108	19.7
5/13/2019	1.28	1.55	*5/13/2019*	3.22	1.86
5/23/2019	2.21	7.5	*5/23/2019*	4.86	7.6
6/17/2019	25.6	84.1	*6/18/2019*	167	50.10
South Fork Salk Creek at Kurtz			*South Fork Salt Creek near Maumee*		
Date	**Discharge (cfs)**	**Turbidity (NTU)**	**Date**	**Discharge (cfs)**	**Turbidity (NTU)**
3/11/2019	90.3	21.00	*3/11/2019*	272	30.1
3/15/2019	179	40.3	*3/15/2019*	627	67.6
4/20/2019	894	108.7	*4/20/2019*	1860	104.3
5/13/2019	25.9	4.31	*5/13/2019*	62.8	11.5
5/23/2019	278	93.7	*5/23/2019*	107	17.6
6/17/2019	386	119.5	*6/17/2019*	2732	140

Existing Conditions of the Affected Environment

Geology and Soils within the Analysis Area

The project area lies within the physiographic region called the Norman Upland. The Norman Upland is known for its rugged topography and entrenched valleys of Salt Creeks and their tributaries were mostly likely formed by glacial meltwater. The bedrock is composed of siltstone from the Mississippian age (Gray, 2000). The soils composed mainly of silt loams and are highly erodible due to the rugged terrain. Soils are rated poor for any kind of disturbance (USDA, 2017).

Hydrology within the Analysis Area

The project area lies within the HUC 10 watershed of South Fork Salt Creek. The South Fork Salt Creek watershed is set as the cumulative effect boundary since monitoring the project-related affects can only be assessed in the project catch basin. Once South Fork Salt Creek basin drains into the Monroe watershed, the draining Middle Fork Salt Creek and North Fork Salt Creek have also contributed effects that cannot be differentiated from the South Fork. The South Fork watershed is comprised of many ephemeral and intermittent streams in the upper watershed headwaters that feed into the lower watershed tributaries: Tipton Creek, Callahan Branch, Starnes Branch, Negro Creek, Little Salt Creek, South Fork Salt Creek, and three unnamed. There are approximately 5,672 acres (29%) of jurisdictional flood plain within the Salt Fork Salt Creek watershed. The 100-yr floodplain is subject to a one percent greater chance of flooding in any given year as defined by E. O. 11988 (USDA Forest Service 1993 a). There are approximately 2833 acres of designated floodplain within the project area (FEMA, 2019). Approximately 14 % of the project area is designated 100-year flood plain. Proposed harvest activity will not occur within the flood plain. There also will be no harvest activity within the Lake Monroe inundation area caused by back water. The jurisdictional 100-yr flood plain is the highest risk area of sedimentation impairing the watershed. Flooded plains can suspend alluvial material and move it directly downstream during high flows. Prescribed burning will occur within the jurisdictional flood plain. Prescribed burning in Hoosier National Forest has shown minimal soil disturbance due to moist vegetative litter protecting wet areas and soils in general (Rigg and Larsen, 2007). There are many wetland areas present or affected as determined by the wetland layer USDA Forest Service ArC GIS Map. A wetland is defined by E.O. 11990 (USDA Forest Service 1992b) as an area inundated by surface or subsurface ground water with frequency sufficient to support prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Most of the wetlands reside in floodplain but there are many small ponds and a few shrub land forested wetlands. There are a few impaired streams within the project boundary. The Little Salt Creek impairment is E. Coli. E. Coli impairment is most likely caused by private land use from pasture or septic. The South Fork Salt Creek and unnamed tributary to South Fork Salt Creek is impaired due to low dissolved oxygen and low biological communities (IndianaMap). Low dissolved oxygen and biological community impairment is driven by the natural hydrology.

Environmental Consequences (Effects) by Alternative

There are two alternative options for this project. One is the no action (Alternative B) and the other is the proposed action (Alternative A). The following section describes the direct, indirect, and cumulative effects to the soil and water resources for both alternatives. As with every Hoosier National Forest project analysis, soil and water quality management and effects to soil and water quality are the primary foci of the soils and water analysis. The Forest Plan has many management requirements that address soil disturbance and detrimental water quality risks that can be identified and used at the project level to reduce them. Table 2 (below) summarizes the proposed action (Alternative A) activity compared to the no action.

Table 2. Projected Disturbance (in acres) by Alternative B.

TREATMENT	ALTERNATIVE A	ALTERNATIVE B
Harvest types:		
Pine Clearcut	401 acres	0
Pine Thinning	78 acres	0
Hardwood Shelterwood	703 acres	0
Hardwood Thinning	2,327 acres	0
Hardwood Selection	462 acres	0
Crop Tree release	170 acres	0
Midstory removal	234 acres	0
~TSI with herbicide	1,973 acres	0
Total Harvest and Timber Treatments area	4,375 acres	**0**
Road Re-Construction (miles/acres)	4.9/9.5	0
Road reconstruction	11.5mi/22.3	0
Road Decommissioning	2.7/5.2	
Log Landings and Skid Trails (acres)	418 acres	0
Total Road Construction, Landings and Skid Trail (acres)	**449.8**	**0**
Prescribed Burn (acres)*	Up to 13,500 acres	0
Constructed Fireline (miles/acres)	**.20**	0
Aquatic Organism Passages (acres)	**4**	0
Total Disturbance area	**454**	**0**

~TSI = Timber stand improvement. This will occur as part of pine clearcut, midstory removal, crop tree release, shelter wood and a portion of selection treatments. Thus it is NOT additive acres, and is not included in the TOTAL Harvest Timber Treatments. The treatments will be in the same spatial areas, but different temporally. Impacts will be the same, opening canopies so more light can reach the forest floor.

*prescribed burns may overlap with timber activities spatially, these acres are counted again here since they will not overlap temporally and will have a different impact to the area than timber activites. This acreage of prescribed burns shows the acreage for initial burns, and assumes the same impacts for later burns of the same areas

Alternative B-No-Action

Direct,Indirect, Cumulative Affects

Erosion will continue to occur at the current rate contributing sediment to streams based on current land use status. Portions of road (2.7 miles) will not be decommisioned to limit access and soil disturbing activities. Trails (2.5 miles) and legacy roads (2.3 miles) won't be maintained to current specifications to mitigate erosion issues. New AOP's will not be constructed widening channel flows through crossings which could reduce channel incision, erosion and sedimentation. Headcut streams will not be restored which could reduce sedimetation of streams. There are no cumulative affects based on no action.

Alternative A – Proposed Action

Direct Effects

Approximately 454 acres (10% of harvest area) of soil will potentially be detrimentally disturbed due to road, landing, skidtrail, AOP,and fireline construction and reconstruction. Direct effects are compaction, rutting, and soil displacement. Detrimentally disturbed soils can adversely affect vegetation, soil productivity and water quality. Water quality direct effects could be local erosion and sedimetation and point source contamination from equipment fluids and herbicide spray. It will be important to apply herbicides with a licensed applicator using best management practices (BMP's). Disturbed soils will require appropriate BMP's discussed further on.

Indirect Effects

Soil Quality

Soil structure can be detrimentally effected from harvests caused by compaction, rutting and extensive erosion. These adverse effects can interupt soil processes. Soil processes include: nutrient (Nitrogen, Phosphorus, Carbon, etc.) cycling from trees and surrounding environment, Soil moisture and infiltration rates can vary before and after harvest which changes the chemical processing rate. Analyzing all these processess is an expensive ineffective way to monitor soil resiliency to endure harvests. The Forest Service has designed a practical method of soil disturbance monitoring that can be measured with set threshholds. Site quality is projected to be maintained if detrimental (DSD) is less than 15% of an area (Powers,1998). Practical measurable indicators were developed to determine if soils were impacted in a detrimental way to disturb their natural chemical and physical processes regime. Those indicaters were mentioned in the Soils Disturbance Monitoring Protocol (USDA, 2009). As long as timber layout is planned to disturb no more than 15 % of the harvest acres, soil processes should maintain adequate soil health for future sustainability.

Fire is an important disturbance mechanism for maintaining forest ecosystems. Although there is a short-lived increase in erosion risk, the benefits gained by keeping invasive plants out and natural plant communities intact is greater than the risk. Fire can affect nutrient availability in

soils. More intense fires can volatize nutrients at a high rate reducing soil's nutrient availability (DeBano, 1990). Fire also can accelerate the rate of organic matter breakdown and provide immediate release of nutrients to soils. Fire typically burns the top organic matter which limits natural breakdown processes that give soils good aggregation. Aggregation gives good soil structure and porosity for water (DeBano, 1990). Some humus and organic material is consumed by fire. Humus and organic material also provide some of the active cation exchange which retains viable soil nutrients. Fires on HNF typically are lower intensity due to climate and vegetation so significant effects to nutrients and organic matter breakdown are not expected but should be monitored since there are trade-offs to fire benefits. Prescribed fire analysis has shown that the typically lower intensity burns only burn the top layer of the organic material leaving the soils and root mass intact (Rigg and Larson, 2007). A precribed fire was done at Fork Ridge within the project area recently on April 3, 2019. Shortly after the burn, several areas were spot checked on how much of the organic layer (O and A horizon) was consumed. The data (Table 3) depicts the results. Unburned areas were compared to burned areas. Differences in O layer show that fire has negligible effect. Fork Ridge burn monitoring was a rapid assessment and only represented a small area. Visual observation of the overall burn area showed a similar mosaic burn pattern throughout.

Table 3- Fork Ridge Burn Data

Fork Ridge	West Slope Avg O layer depth(cm)	East Slope Avg O layer depth (cm)
Unburned	1.5	3.5
Burned	2.5	3.25

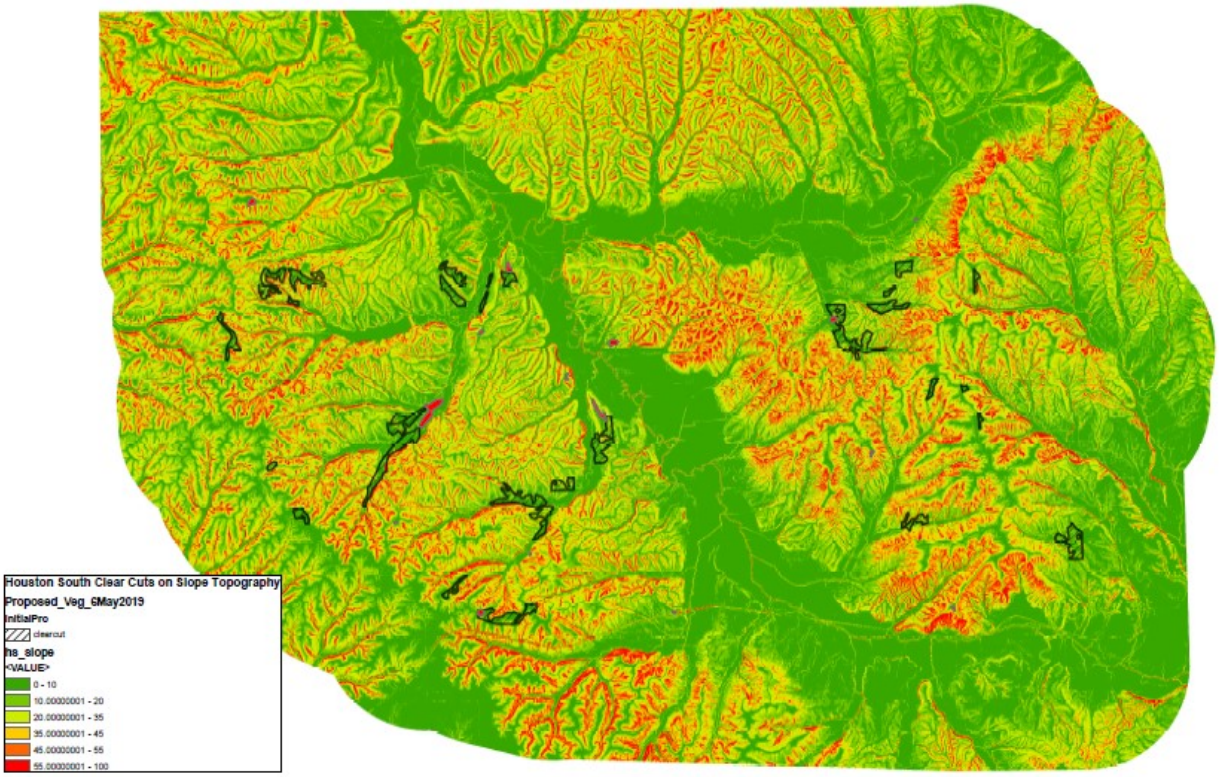
Post-burn soil-stabilizing vegetation recovers within six months of the prescribed burn (Rigg and Larson, 2007). Pictures (Figure 3) were taken of the Fork Ridge burn on June 13, 2019 verifying quick revegatative growth. Soil disturbance monitoring will be done to evaluate and mitigate potential soil disturbance issues caused by fire.

Figure 3- Fork Ridge Post-Burn approximately 2 months after burn.

Water Quality

There are inherent risks imposed to soil and water resources just by removing trees. One risk is initial higher water yields (moisture and run-off) reducing tree canopy and water uptake. Tree canopy intercepts many raindrops that never hit the forest floor. These droplets are returned to the atmosphere through evapotranspiration. Canopy removal increases soil moisture due to lack of interception and water uptake (NRC, 2008). Soils are then exposed to higher and longer periods of moisture. Increased and longer soil moisture periods can impose higher risk of slumps and slides based on local soil characteristics. Slumps and slides can cause detrimental impacts to water quality due to increased sediment loads in drainages and streams. Fortunately, only 9% of harvest acres (401 acres) will be clearcut. Water yield increase is difficult to detect when twenty percent or less of the harvest is cut (NRC, 2008). All clearcuts are proposed on lesser sloped ground which should reduce risk of slumps and slides. Figure 3 shows clearcuts and related slopes.

Figure 3- Slope in Relation to Clear Cuts



Prolonged erosion can be a major indirect effect. Not only does sediment contaminate water but also the nutrients living in sediment can pose risks to water.The risk of excess nutrification from sediment runoff is a plausiblie concern. Excessive nutrient and sediment run off can contribute to increase in eutrophication rates of streams and lakes. This flush of nutrients can cause harmful algae blooms within the watershed. Adequate BMP's can keep excessive soil erosion from being detrimental to water quality (Jones, 1997). Overload of nutrients are a common problem in Indiana and usually caused from agricutural practices such as row crops and pasture/rangelands (Bunch, 2016). Managed and unmanaged forests have long been associated with highest water quality when compared to other land uses (IDNR, 2008). The Pate Hollow study states that 10-15% of the watershed needs to be clearcut for any changes in water quality to be observable (Moss, 1995). This study has similar soil types and topography. Only 9.2% of the harvest acres within harvest area of project will be clearcut and the project area only resides within 36% of the South Fork Salt Creek watershed. Re-introducing fire to the landscape can impact water quality and increase sedimentation. Results from recent studies have shown that low-intensity, low-severity precribed burns could be used to restore vegetation structure and composition in mixed pine-hardwood ecosystems without negatively impacting water quality (Elliot and Vose, 2005).

Cumulative Effects

The Forest Service is aware that activities on private land have included timber harvesting, grazing, agriculture activities, and other minor residential disturbances, all of which can reduce soil and water quality. Aproximately 1,153 acres of agricultural land resides within South Fork Salt Creek watershed flood plain.

Figure 4 – Tractor surrounded by flood water debris from South Fork Salt Creek

Historically, best management practices may not have been applied commonly on private lands. Private land owners have been encouraged over the last decades to adopt soil and water conservation practices. However, even when such practices are employed during an activity, consistent long-term maintenance practices to control erosion and sedimentation from disturbances are less likely to have been/be implemented for many private land uses.

Agriculture, timbering, residential development and associated activities are expected to continue in the future. Additional new soil disturbances also have been occurring on private land, including recreational use of off-road vehicles. Future actions will add to historic soil disturbances resulting in even more soil and water quality degradation. Furthermore, since

private lands have typically been less regulated and are expected to remain less regulated in the future, soil-disturbing activities that negatively affect soil and water quality will still persist.

Although there are imposed risks to the soils from harvesting and burning, correctly implemented BMP's will mitigate them. There are several degrading roads and trails that are currently impacting the Salt Creek Watershed in a negative way due to sedimentation. Although approximately 11.5 miles of new road will be created, a minimum of 2.5 miles of trail and 2.3 miles of road disturbance that were field assessed will be rehabilitated to road and trail specifications which will minimize erosion instead of exacerbate at the current rate. Table 4 below, documents observed and known legacy disturbed routes used for new road constructon.

Table 4 – Legacy disturbance

Road #	**Legacy Disturbance**	Distance (feet)
NR6	Road	3253
NR8	HR Trail 3	3009
NR 11	HRTrail 11	1312
NR12	HR Trail 3	2903
NR15	Road	5951
NR17	HR Trail 22	1481
NR18	HR Trail 15	2600
NR19	HR Trail 16	1276
NR22	FR Trail 1	935
NR24	Road	1605
NR25	Road	1309

Some of the roads and trails will be rehabilitated with BMP measures to reduce erosion/sedimentation. There are several head cut ephemeral and intermittent streams that should be repaired using watershed restoration techniques.

Figure 5- Head cut intermittent stream along Hickory Ridge Trail.

The Pate Hollow Study documents that water quality is not detrimentally affected by harvests in similar geological, topographic and soils regimes as Houston South (Moss, 1995). Managed and unmanaged forests have long been associated with highest water quality when compared to other land uses (IDNR, 2008). Long-term soil and water quality within the Houston South Project should remain the same or be slightly improved based on initial disturbances and long-term improvements as long as BMP's and mitigation practices are utilized.

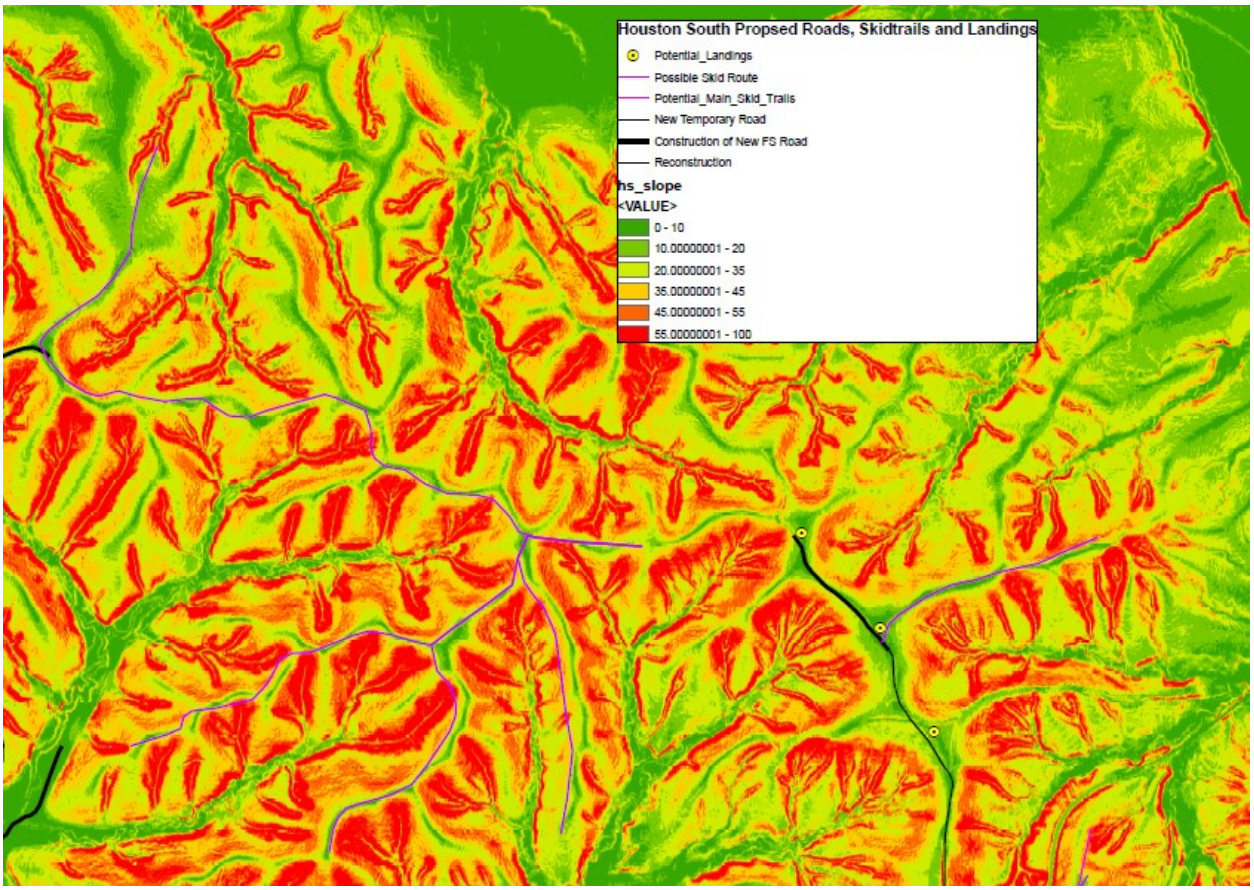
Best Management Practices

Although forest cover provides maximum run-off and erosion control benefits, steep slopes on much of the forested land exists in the South Fork Salt Creek watershed. These conditions encourage greater run-off, sediment and nutrient losses than otherwise observed on flatter slopes. Ground disturbing activities have to be implemented and mitigated for appropriately. There are adequate BMP's that can be used for this terrain (Jones, 1997). There is a 96.5% effectiveness of BMP's on federal lands based on past twenty years of data (IDNR, 1998).The BMP's from the Forest Plan, and Indiana Logging Guide, and others mentioned below are all considered adequate by State and Federal agencies. BMPs are emplemented and monitored routinely by HNF by staff." The implementation of forestry BMPs have been proven over the years to be very effective in reducing watershed erosion and run-off (Jones, 1997)."

Harvesting causes different level of impacts to the soils/water resources based on the type of activity within the harvest unit. Landings, roads, and skid trails have been proven to be the most detrimental. These areas are impacted due to long-term heavy equipment use during harvesting. It is important to incorporate appropriate BMPs and locations to mitigate these detrimental impacts. Only 3,971 harvest acres will utilize heavy equipment (skidders, haul trucks, etc). The remaining 404 acres will be handcut with chainsaws. All BMPS are documented in the HNF Land and Resource Plan " (USDA, 2006).

Landings are a main thorofare for timber to be sorted and loaded. The intense use of this area imposes high risk to soil and water quality. Log landings should be designated by Forest Service personnel and located on upland well-drained, relatively level ground to minimize surface runoff and soil erosion (USDA, 2006). Soil compaction is a potential risk which limits root growth for vegetation cover, accelerates surface erosion, and inhibits soils processes. A log landing should never reside in plastic soils (clay forming) within 12 inches of the water table (USDA, 2006). Operating during wet conditions should be prohibited to limit rutting and compaction therefore reducing surface runoff, soil erosion and loss of soil nutrients (USDA, 2006).
Topsoil should be stockpiled and returned to landing to mitigate disturbances that inhibit vegetatitive growth (USDA, 2006). When operations are complete, prepare landings to provide favorablesite conditions for seed germination. Prescribed seeding (HNF mix, Pollinator, etc.) of landings need to be done along with mulch to prevent erosion (USDA, 2006). It is recommended that a minimum of 7 inches is roughed up for water infiltration and root growth. If landing operations extend over a number of operating seasons, mulching exposed areas may be required to reduce surface erosion (USDA, 2006). If the landing is detrimentally affected based on soil disturbance monitoring or visual observation, subsoiling and/or soil amendment (nutrient additives) and reseeding may be required. Where topsoil is less than 1 inch thick or organic matter is less than 2% , retain logging slash in place for establishment of organic material for soil (USDA, 2006).

Skid Trails are also a detrimental risk imposed on soil and water resources on the harvest unit. Skidders traverse the terrain hauling timber from the cut area to the landing area. Allthough a lot of the terrain in Houston South is relatively steep, harvesting can be done with appropriate BMPs and equipment. It is highly recommended that track skidders and dozers are utilized within the Houston South project area. Track driven equipment are more evenly distributed on weight and manuever with less disturbance on steeper terrain than tire skidders. It is recommended that skid trails should reside on a stable high point of a ridge to ensure minimal soil disturbance and erosion. Figure 4 shows a Houston South portion of recommended skid trails, roads, and landings on relatively flatter ground.



All skid trails require waterbars to mitigate erosion as recommended by the Logging and Forestry BMP's for Water Quality in Indiana (2005) and Hoosier LMP (USDA, 2006) BMP example recommended by the guide would be slopes greater than 35% require 30 feet spacing of waterbars. Skidders should remain on skid trails and only remove trees by cabling methods from areas not designated to trail if slope is greater than 35 percent (USDA, 2006). Log skidding and heavy equipment is prohibited within streambeds (USDA, 2006). Inevitably, intermittent, perenial streams and small drainages need crossed. Small drainages are dry duriing a majority of a harvesting season which limits soil and water impact. Considering adaptive harvest methods by temporarily depositing slash as transport crossing pad during non-flowing periods to minimize drainage slope erosion. Revert to the "Logging and Forestry BMP's for Water Quality in Indiana Handbook" (IDNR, 2005) for further BMP implermentation regarding stream crossings. Operating during wet conditions should be prohibited to limit rutting and compaction therefore reducing surface runoff, soil erosion and loss of soil nutrients (USDA, 2006). If skidding operations extend over a number of operating seasons, mulching exposed areas may be required to reduce surface erosion (USDA, 2006). When operations are complete, preparing skid trails to provide favorablesite conditions for revegetation may be required with seed and mulch . If the skid trail is detrimentally affected based on soil disturbance monitoring or visual observation, subsoiling and/or soil amendment (nutrient additives) and reseeding may be required. Where topsoil is less than 1 inch thick or organic matter is less than 2% , retain logging slash in place for establishment of organic material for soil (USDA, 2006).

Roads can increase erosion and sedimentation more than any other practice associated with forest management. Proposed constructed road locations are mainly on high ground and **only intermittent or ephemeral streams will be crossed for new road construction**. In general, roads will not be constructed in riparian corridors unless no practical alternatives exist. Road approaches to streams will be located to minimize erosion and sediment introduction to the stream. Roads will generally cross channels at right angles. Channel crossings will be accomplished using bridges,, culverts, fords, or other appropriate crossing structures according to site specific conditions. Unnecessary crossings should be removed when road is decommissioned. Reconstruction and stabilization of existing roads within riparian corridors is permitted. Natural hydrologic drainage regime should be maintained with adequate drainage structures and design. Road surfaces should be maintain using aggregate or suitable erosion control cover within riparian corridors. Minimize cuts and placement of fills while building new roads in wetlands and riparian corridors. (USDA, 2006)

There are other BMP provisions that need to be addressed for general timber harvest activity. Riparian corridors will consist of the riparian area and adjacent terrestrial ecosystem for a combined of 25 to 100 foot corrider depending on the type of stream. Permanent water bodies should have 100 feet buffer from any activity. Ephemeral streams require a minimum of 25 feet buffer and intermittent stream requires a minimum of 50 feet buffer (USDA, 2006). Waterholes or small ponds up to a half acre with slopes no more than 5% should have a 25 foot buffer. Ephemeral and intermittent streams will be crossed when absolutely necessary but crossings should be limited (USDA, 2006). Keep slash out of waterbodies, stream channels, floodplains, and areas where it may be swept into streams, except to meet other stream restoration objectives (USDA, 2006). Soil-disturbing activities of approved practices within designated riparian corridors will require effective erosion control. Implement, as needed, erosion control measures such as straw bales in ditch lines and small drainages, berms in road embankments during construction, diversion ditches, slash andunmerchantable logs across slopes and trails, check dams in ditch lines, sediment detention basins, and sediment fences (USDA, 2006).

Prescribed fire operations do cause soil disturbance and risks to the watershed. Most of the fireline will be non-disturbing with use of mowing. Blowing and tree cutting. But 0.20 miles will be dozed creating more inherent risk. Where possible, use natural or existing man-made barriers forfire control and as boundaries on precsribed.Avoid creating dozed fire lines in riparian areas fire (USDA, 2006). Dozed fireline must be maintained using BMPs and soil eroision mitigation methods. Equipment containing fuels (oil, gas, torch fluid, etc) need to be maintained and used safely away from water sources.

NNIS treatment and silviculture treatments with herbicides can pose threat to water quality. As long as safety operation protocol is utilized with licensed applicator, chemical treatment using BMP's should not pose a great risk. All water quality risks imposed on the chemicals themselves are documented in the Nonnative Invasive Species Plant Control Program Analysis HNF are assessed (USDA, 2009). Long-term detrimental effects to water quality are expected.

Consistency with the Forest Plan

The goals of the project are consistent with the Forest Plan

- Maintain and Restore Sustainable Ecosystems
- Maintain and Restore Watershed Health

Consistency with Laws, Regulations, and Handbooks

- All alternatives would be implemented in a manner consistent with Forest Service laws, regulations, and handbooks regarding management of the aquatic resources.

Recommended Design Measures to Soil and Water Resource Concerns

- Only trained herbicide applicators
- Don't apply non-aquatic herbicide near ponds or streams
- Follow Forest Plan guidelines for harvesting near riparian areas and steep slopes
- Implement forestry BMPs for all timber sales within the project area
- Mitigate unforeseen erosion and sedimentation issues immediately (slash deposits, straw bales, silt fences, re-contouring landscape, silt traps, etc.)
- Monitor all active areas routinely

Title	Date Created	Latitude
top of ridge steep om bothsidescwhere harvest	2019-03-21 01:23:37 PM Eastern Daylight Time	38.98205
high sharp turn	2019-03-21 01:29:29 PM Eastern Daylight Time	38.98345
cut and fill slope	2019-03-21 01:30:14 PM Eastern Daylight Time	38.9844
narrow sreep and entrenched	2019-03-21 01:34:48 PM Eastern Daylight Time	38.98462
Placemark 1	2019-03-21 01:39:50 PM Eastern Daylight Time	38.98331
small drainage	2019-03-21 12:02:36 AM Eastern Daylight Time	38.98669
soggy	2019-03-21 12:06:45 AM Eastern Daylight Time	38.98752
intermittent crossing	2019-03-21 12:09:13 AM Eastern Daylight Time	38.98812
downhillheadcut	2019-03-21 12:10:52 AM Eastern Daylight Time	38.9884
trail headcut	2019-03-21 12:13:06 AM Eastern Daylight Time	38.98876
headwater trib to starnes	2019-03-21 12:23:52 AM Eastern Daylight Time	38.98583
starnesheadwatercrossing	2019-03-21 12:27:15 AM Eastern Daylight Time	38.98469
headcutroadsection	2019-03-21 12:31:53 AM Eastern Daylight Time	38.98606
minor channel incision rip buffer	2019-03-21 12:34:01 AM Eastern Daylight Time	38.98607
headcut drainage crossing	2019-03-21 12:35:41 AM Eastern Daylight Time	38.9861
headcut entrenched road across drainage	2019-03-21 12:38:40 AM Eastern Daylight Time	38.98595

headcut down tochanery 2ft	2019-03-21 12:40:13 AM Eastern Daylight Time	38.98588
downhill headcut rill along trail road	2019-03-21 12:46:03 AM Eastern Daylight Time	38.98711
headcut rill	2019-03-21 12:47:55 AM Eastern Daylight Time	38.98773
Trail 3 rill erosion	2019-04-02 01:19:36 PM Eastern Daylight Time	38.98873
Small headcut	2019-04-02 01:21:40 PM Eastern Daylight Time	38.98873
Gullying	2019-04-02 01:23:37 PM Eastern Daylight Time	38.98873
Entrenched rill	2019-04-02 01:29:04 PM Eastern Daylight Time	38.99063
Entrenched rill	2019-04-02 01:38:50 PM Eastern Daylight Time	38.99348
Emtrenched compacted	2019-04-02 01:50:17 PM Eastern Daylight Time	38.99137
Headcut gullying	2019-04-02 01:55:29 PM Eastern Daylight Time	38.98949
Oldroad/trail	2019-04-02 02:28:22 PM Eastern Daylight Time	39.00522
Entrenched rill erosion	2019-04-02 02:31:48 PM Eastern Daylight Time	39.0051
Start ofGreat recovered road that will be used	2019-04-02 02:50:28 PM Eastern Daylight Time	39.00554
Great finish of recovered tral	2019-04-02 02:57:21 PM Eastern Daylight Time	39.0056
Start of entrenched headcut	2019-04-02 03:00:40 PM Eastern Daylight Time	39.00586
Endofentrench	2019-04-02 03:02:12 PM Eastern Daylight Time	39.0059
Placemark 2start of severe headcount entrench	2019-04-02 03:04:28 PM Eastern Daylight Time	39.0059
Severe beadcut	2019-04-02 03:06:15 PM Eastern Daylight Time	39.00576
Severe headcut	2019-04-02 03:08:06 PM Eastern Daylight Time	39.00567
Severe headcut	2019-04-02 03:10:00 PM Eastern Daylight Time	39.00552
End of severe headcut but still severely entrenched	2019-04-02 03:13:27 PM Eastern Daylight Time	39.00515
End of entrenchment	2019-04-02 03:18:19 PM Eastern Daylight Time	39.005
New road Looks good	2019-04-02 03:43:11 PM Eastern Daylight Time	39.00088
Looks good new road	2019-04-02 03:46:28 PM Eastern Daylight Time	39.00109
New road 'looks good	2019-04-02 03:51:02 PM Eastern Daylight Time	39.00057
Gets sreep	2019-04-02 03:54:09 PM Eastern Daylight Time	39.00103
Start of trail head 3	2019-04-02 12:31:24 AM Eastern Daylight Time	38.97573
Entrenched trail turned to new road?	2019-04-02 12:34:11 AM Eastern Daylight Time	38.97573
Entrenched section of trail converged to road?	2019-04-02 12:36:42 AM Eastern Daylight Time	38.97557
Entrenched section	2019-04-02 12:44:59 AM Eastern Daylight Time	38.97911
Entrenched section	2019-04-02 12:51:04 AM Eastern Daylight Time	38.98122
End of road looks good	2019-04-05 01:01:06 PM Eastern Daylight Time	38.96358
No road why need it	2019-04-05 01:13:50 PM Eastern Daylight Time	38.96324
Getscsteep	2019-04-05 01:17:32 PM Eastern Daylight Time	38.95992
Steep drainage very close to east	2019-04-05 01:23:12 PM Eastern Daylight Time	38.9583

Steep drainage pass?	2019-04-05 01:26:58 PM Eastern Daylight Time	38.95791
Sandstone cliffs	2019-04-05 01:28:16 PM Eastern Daylight Time	38.958
Leveled road with drain culvert	2019-04-05 01:31:33 PM Eastern Daylight Time	38.95812
Rr narrows 12feet	2019-04-05 01:44:32 PM Eastern Daylight Time	38.96042
Landowners stuff	2019-04-05 01:48:25 PM Eastern Daylight Time	38.96042
North of rr is us	2019-04-05 01:58:55 PM Eastern Daylight Time	38.96163
Stream natural head cut	2019-04-05 02:07:06 PM Eastern Daylight Time	38.96244
Old road headcount bypassing gate	2019-04-05 11:32:42 AM Eastern Daylight Time	38.96318
Deepcut drainages	2019-04-05 11:38:17 AM Eastern Daylight Time	38.96278
Wildlife opening	2019-04-05 11:43:04 AM Eastern Daylight Time	38.9632
road not bad yet no entrenched and trees	2019-04-05 11:47:17 AM Eastern Daylight Time	38.96395
Wet drainage protect pattern	2019-04-05 11:50:26 AM Eastern Daylight Time	38.96467
Entrenched rill need wayerbars	2019-04-05 12:00:14 AM Eastern Daylight Time	38.96534
Headcount downside bill	2019-04-05 12:03:59 AM Eastern Daylight Time	38.9648
Headcount 60	2019-04-05 12:08:27 AM Eastern Daylight Time	38.96483
Rill erosion need waterbar	2019-04-05 12:14:11 AM Eastern Daylight Time	38.96493
Headcut75feet	2019-04-05 12:16:28 AM Eastern Daylight Time	38.9647
Start of cut poorly drained	2019-04-05 12:20:51 AM Eastern Daylight Time	38.96437
Entrenched bust out some warebars drainage	2019-04-05 12:37:33 AM Eastern Daylight Time	38.96338
Westpot drain	2019-04-05 12:39:34 AM Eastern Daylight Time	38.96329
Start of headcut	2019-04-05 12:42:47 AM Eastern Daylight Time	38.96329
End of hc	2019-04-05 12:45:06 AM Eastern Daylight Time	38.96319
Steep embakment	2019-04-05 12:48:28 AM Eastern Daylight Time	38.96306
Opening Westport drainage uphill needed	2019-04-05 12:51:42 AM Eastern Daylight Time	38.96172
Trailhead 22	2019-04-09 10:27:33 AM Eastern Daylight Time	38.98154
Poorly drained needs contoured	2019-04-09 10:31:25 AM Eastern Daylight Time	38.99014
Start of some rill	2019-04-09 10:43:35 AM Eastern Daylight Time	38.99452
Rill downslope	2019-04-09 10:52:59 AM Eastern Daylight Time	38.99168
Trail rated good to fair condition	2019-04-09 10:55:29 AM Eastern Daylight Time	38.99084
Exile of steep drainage along road trail in good shape	2019-04-09 10:58:51 AM Eastern Daylight Time	38.99109
Start filled i	2019-04-09 11:35:02 AM Eastern Daylight Time	38.98459
Opening and headcut	2019-04-09 11:40:44 AM Eastern Daylight Time	38.98494
Minor trenching	2019-04-09 11:59:05 AM Eastern Daylight Time	38.98422
Slightly entrenched blown watermark trail 16/22	2019-04-09 12:10:04 AM Eastern Daylight Time	38.98412
Control soil layer1	2019-04-15 11:51:41 AM Eastern Daylight Time	38.99507

Sample burn 1	2019-04-15 11:56:58 AM Eastern Daylight Time	38.99507
Burnsample 2	2019-04-15 12:02:05 AM Eastern Daylight Time	38.99515
Control burn 2	2019-04-15 12:07:19 AM Eastern Daylight Time	38.99517
West slope burn site 3	2019-04-15 12:13:17 AM Eastern Daylight Time	38.99517
Control 3 east slope	2019-04-15 12:20:13 AM Eastern Daylight Time	38.99538
Control 4 east side	2019-04-15 12:23:41 AM Eastern Daylight Time	38.99538
Sample 4 in burn	2019-04-15 12:27:27 AM Eastern Daylight Time	38.99539
New road no legacy trail!	2019-04-17 01:38:12 PM Eastern Daylight Time	39.01005
20% 12cm o layer	2019-04-17 01:44:48 PM Eastern Daylight Time	39.0088
20% 8 cm o layer	2019-04-17 01:48:26 PM Eastern Daylight Time	39.00859
Pond	2019-04-17 01:53:19 PM Eastern Daylight Time	39.0082
15% 10 cm o	2019-04-17 02:05:08 PM Eastern Daylight Time	39.00978
20% 10cmO	2019-04-17 02:10:20 PM Eastern Daylight Time	39.00932
15% 9 cm O	2019-04-17 02:13:29 PM Eastern Daylight Time	39.00906
10% 6cm O	2019-04-17 02:24:02 PM Eastern Daylight Time	39.01035
20-25% slopes 8cm O	2019-04-17 03:05:44 PM Eastern Daylight Time	39.01033
25% 5cmO	2019-04-17 03:10:11 PM Eastern Daylight Time	39.00995
Small intermittent stream 10-20% channel 2_3 feet wide	2019-04-17 03:14:33 PM Eastern Daylight Time	39.0096
35% 4cm O	2019-04-17 03:22:07 PM Eastern Daylight Time	39.01079
10% 7cm O	2019-04-17 03:39:15 PM Eastern Daylight Time	39.00999
Start of headcutdrainage could be filled in with slash	2019-04-17 03:43:36 PM Eastern Daylight Time	39.00999
20-25% 3cm O on headcount drainage 30_40%	2019-04-17 03:49:42 PM Eastern Daylight Time	39.0091
10_15% 4cm O	2019-04-17 04:00:02 PM Eastern Daylight Time	39.00847
Legacy road	2019-06-03 11:00:02 AM Eastern Daylight Time	38.99176
Legacy timber trail	2019-06-03 11:23:09 AM Eastern Daylight Time	39.00178
Newdisturbance	2019-06-03 11:49:07 AM Eastern Daylight Time	39.01273

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Attachment 1-Basic field notes from GPS tablet documenting existing erosion

Title	Date Created	Latitude
top of ridge steep om bothsidescwhere harvest	2019-03-21 01:23:37 PM Eastern Daylight Time	38.98205
high sharp turn	2019-03-21 01:29:29 PM Eastern	38.98345

	Daylight Time	
cut and fill slope	2019-03-21 01:30:14 PM Eastern Daylight Time	38.9844
narrow sreep and entrenched	2019-03-21 01:34:48 PM Eastern Daylight Time	38.98462
Placemark 1	2019-03-21 01:39:50 PM Eastern Daylight Time	38.98331
small drainage	2019-03-21 12:02:36 AM Eastern Daylight Time	38.98669
soggy	2019-03-21 12:06:45 AM Eastern Daylight Time	38.98752
intermittent crossing	2019-03-21 12:09:13 AM Eastern Daylight Time	38.98812
downhillheadcut	2019-03-21 12:10:52 AM Eastern Daylight Time	38.9884
trail headcut	2019-03-21 12:13:06 AM Eastern Daylight Time	38.98876
headwater trib to starnes	2019-03-21 12:23:52 AM Eastern Daylight Time	38.98583

starnesheadwatercrossing	2019-03-21 12:27:15 AM Eastern Daylight Time	38.98469
headcutroadsection	2019-03-21 12:31:53 AM Eastern Daylight Time	38.98606
minor channel incision rip buffer	2019-03-21 12:34:01 AM Eastern Daylight Time	38.98607
headcut drainage crossing	2019-03-21 12:35:41 AM Eastern Daylight Time	38.9861
headcut entrenched road across drainage	2019-03-21 12:38:40 AM Eastern Daylight Time	38.98595
headcut down tochanery 2ft	2019-03-21 12:40:13 AM Eastern Daylight Time	38.98588
downhill headcut rill along trail road	2019-03-21 12:46:03 AM Eastern Daylight Time	38.98711
headcut rill	2019-03-21 12:47:55 AM Eastern Daylight Time	38.98773
Trail 3 rill erosion	2019-04-02 01:19:36 PM Eastern Daylight Time	38.98873
Small headcut	2019-04-02 01:21:40 PM	38.98873

	Eastern Daylight Time	
Gullying	2019-04-02 01:23:37 PM Eastern Daylight Time	38.98873
Entrenched rill	2019-04-02 01:29:04 PM Eastern Daylight Time	38.99063
Entrenched rill	2019-04-02 01:38:50 PM Eastern Daylight Time	38.99348
Emtrenched compacted	2019-04-02 01:50:17 PM Eastern Daylight Time	38.99137
Headcut gullying	2019-04-02 01:55:29 PM Eastern Daylight Time	38.98949
Oldroad/trail	2019-04-02 02:28:22 PM Eastern Daylight Time	39.00522
Entrenched rill erosion	2019-04-02 02:31:48 PM Eastern Daylight Time	39.0051
Start ofGreat recovered road that will be used	2019-04-02 02:50:28 PM Eastern Daylight Time	39.00554
Great finish of recovered tral	2019-04-02 02:57:21 PM Eastern Daylight	39.0056

	Time	
Start of entrenched headcut	2019-04-02 03:00:40 PM Eastern Daylight Time	39.00586
Endofentrench	2019-04-02 03:02:12 PM Eastern Daylight Time	39.0059
Placemark 2start of severe headcount entrench	2019-04-02 03:04:28 PM Eastern Daylight Time	39.0059
Severe beadcut	2019-04-02 03:06:15 PM Eastern Daylight Time	39.00576
Severe headcut	2019-04-02 03:08:06 PM Eastern Daylight Time	39.00567
Severe headcut	2019-04-02 03:10:00 PM Eastern Daylight Time	39.00552
End of severe headcut but still severely entrenched	2019-04-02 03:13:27 PM Eastern Daylight Time	39.00515
End of entrenchment	2019-04-02 03:18:19 PM Eastern Daylight Time	39.005
New road Looks good	2019-04-02 03:43:11 PM Eastern Daylight Time	39.00088
Looks good new road	2019-04-02	39.00109

	03:46:28 PM Eastern Daylight Time	
New road 'looks good	2019-04-02 03:51:02 PM Eastern Daylight Time	39.00057
Gets sreep	2019-04-02 03:54:09 PM Eastern Daylight Time	39.00103
Start of trail head 3	2019-04-02 12:31:24 AM Eastern Daylight Time	38.97573
Entrenched trail turned to new road?	2019-04-02 12:34:11 AM Eastern Daylight Time	38.97573
Entrenched section of trail converged to road?	2019-04-02 12:36:42 AM Eastern Daylight Time	38.97557
Entrenched section	2019-04-02 12:44:59 AM Eastern Daylight Time	38.97911
Entrenched section	2019-04-02 12:51:04 AM Eastern Daylight Time	38.98122
End of road looks good	2019-04-05 01:01:06 PM Eastern Daylight Time	38.96358
No road why need it	2019-04-05 01:13:50 PM Eastern	38.96324

	Daylight Time	
Getscsteep	2019-04-05 01:17:32 PM Eastern Daylight Time	38.95992
Steep drainage very close to east	2019-04-05 01:23:12 PM Eastern Daylight Time	38.9583
Steep drainage pass?	2019-04-05 01:26:58 PM Eastern Daylight Time	38.95791
Sandstone cliffs	2019-04-05 01:28:16 PM Eastern Daylight Time	38.958
Leveled road with drain culvert	2019-04-05 01:31:33 PM Eastern Daylight Time	38.95812
Rr narrows 12feet	2019-04-05 01:44:32 PM Eastern Daylight Time	38.96042
Landowners stuff	2019-04-05 01:48:25 PM Eastern Daylight Time	38.96042
North of rr is us	2019-04-05 01:58:55 PM Eastern Daylight Time	38.96163
Stream natural head cut	2019-04-05 02:07:06 PM Eastern Daylight Time	38.96244

Old road headcount bypassing gate	2019-04-05 11:32:42 AM Eastern Daylight Time	38.96318
Deepcut drainages	2019-04-05 11:38:17 AM Eastern Daylight Time	38.96278
Wildlife opening	2019-04-05 11:43:04 AM Eastern Daylight Time	38.9632
road not bad yet no entrenched and trees	2019-04-05 11:47:17 AM Eastern Daylight Time	38.96395
Wet drainage protect pattern	2019-04-05 11:50:26 AM Eastern Daylight Time	38.96467
Entrenched rill need wayerbars	2019-04-05 12:00:14 AM Eastern Daylight Time	38.96534
Headcount downside bill	2019-04-05 12:03:59 AM Eastern Daylight Time	38.9648
Headcount 60	2019-04-05 12:08:27 AM Eastern Daylight Time	38.96483
Rill erosion need waterbar	2019-04-05 12:14:11 AM Eastern Daylight Time	38.96493
Headcut75feet	2019-04-05 12:16:28	38.9647

	AM Eastern Daylight Time	
Start of cut poorly drained	2019-04-05 12:20:51 AM Eastern Daylight Time	38.96437
Entrenched bust out some warebars drainage	2019-04-05 12:37:33 AM Eastern Daylight Time	38.96338
Westpot drain	2019-04-05 12:39:34 AM Eastern Daylight Time	38.96329
Start of headcut	2019-04-05 12:42:47 AM Eastern Daylight Time	38.96329
End of hc	2019-04-05 12:45:06 AM Eastern Daylight Time	38.96319
Steep embakment	2019-04-05 12:48:28 AM Eastern Daylight Time	38.96306
Opening Westport drainage uphill needed	2019-04-05 12:51:42 AM Eastern Daylight Time	38.96172
Trailhead 22	2019-04-09 10:27:33 AM Eastern Daylight Time	38.98154
Poorly drained needs contoured	2019-04-09 10:31:25 AM Eastern Daylight	38.99014

Start of some rill	2019-04-09 10:43:35 AM Eastern Daylight Time	38.99452
Rill downslope	2019-04-09 10:52:59 AM Eastern Daylight Time	38.99168
Trail rated good to fair condition	2019-04-09 10:55:29 AM Eastern Daylight Time	38.99084
Exile of steep drainage along road trail in good shape	2019-04-09 10:58:51 AM Eastern Daylight Time	38.99109
Start filled i	2019-04-09 11:35:02 AM Eastern Daylight Time	38.98459
Opening and headcut	2019-04-09 11:40:44 AM Eastern Daylight Time	38.98494
Minor trenching	2019-04-09 11:59:05 AM Eastern Daylight Time	38.98422
Slightly entrenched blown watermark trail 16/22	2019-04-09 12:10:04 AM Eastern Daylight Time	38.98412
Control soil layer1	2019-04-15 11:51:41 AM Eastern Daylight Time	38.99507
Sample burn 1	2019-04-15	38.99507

	11:56:58 AM Eastern Daylight Time	
Burnsample 2	2019-04-15 12:02:05 AM Eastern Daylight Time	38.99515
Control burn 2	2019-04-15 12:07:19 AM Eastern Daylight Time	38.99517
West slope burn site 3	2019-04-15 12:13:17 AM Eastern Daylight Time	38.99517
Control 3 east slope	2019-04-15 12:20:13 AM Eastern Daylight Time	38.99538
Control 4 east side	2019-04-15 12:23:41 AM Eastern Daylight Time	38.99538
Sample 4 in burn	2019-04-15 12:27:27 AM Eastern Daylight Time	38.99539
New road no legacy trail!	2019-04-17 01:38:12 PM Eastern Daylight Time	39.01005
20% 12cm o layer	2019-04-17 01:44:48 PM Eastern Daylight Time	39.0088
20% 8 cm o layer	2019-04-17 01:48:26 PM Eastern	39.00859

	Daylight Time	
Pond	2019-04-17 01:53:19 PM Eastern Daylight Time	39.0082
15% 10 cm o	2019-04-17 02:05:08 PM Eastern Daylight Time	39.00978
20% 10cmO	2019-04-17 02:10:20 PM Eastern Daylight Time	39.00932
15% 9 cm O	2019-04-17 02:13:29 PM Eastern Daylight Time	39.00906
10% 6cm O	2019-04-17 02:24:02 PM Eastern Daylight Time	39.01035
20-25% slopes 8cm O	2019-04-17 03:05:44 PM Eastern Daylight Time	39.01033
25% 5cmO	2019-04-17 03:10:11 PM Eastern Daylight Time	39.00995
Small intermittent stream 10-20% channel 2_3 feet wide	2019-04-17 03:14:33 PM Eastern Daylight Time	39.0096
35% 4cm O	2019-04-17 03:22:07 PM Eastern Daylight Time	39.01079

10% 7cm O	2019-04-17 03:39:15 PM Eastern Daylight Time	39.00999
Start of headcutdrainage could be filled in with slash	2019-04-17 03:43:36 PM Eastern Daylight Time	39.00999
20-25% 3cm O on headcount drainage 30_40%	2019-04-17 03:49:42 PM Eastern Daylight Time	39.0091
10_15% 4cm O	2019-04-17 04:00:02 PM Eastern Daylight Time	39.00847
Legacy road	2019-06-03 11:00:02 AM Eastern Daylight Time	38.99176
Legacy timber trail	2019-06-03 11:23:09 AM Eastern Daylight Time	39.00178
Newdisturbance		2019-06-03 11:49:07 AM Eastern Daylight Time